NORTH CAROLINA
Department of Transportation

OSHA Focus Four - Electrocution

Common Hazards

Common hazards when working with energized electrical equipment include:

- Electric Shock / Burns
- Blast
- Arc Flash

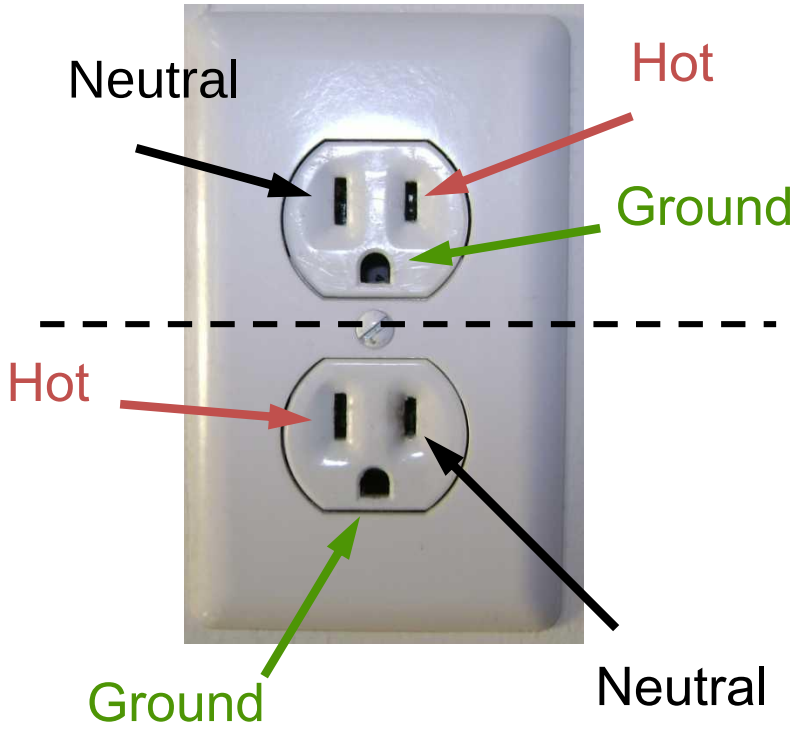
Fast Fact: It doesn't take much for human skin to burn – in fact an exposure of 203 F for just one-tenth of a second (6 cycles) is enough to cause a third degree burn!

Wiring Design and Protection

1926.404(a)(2)

- Polarity of connections
  - No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity

Correct Polarity

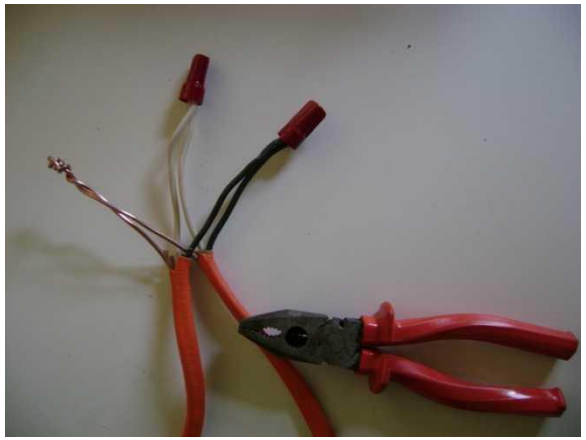


Reversed Polarity

General Requirements

1926.403(e)

- Splices
  - Splicing devices suitable for use
  - Welding/brazing/soldering
  - Mechanically/electrically secure before soldering
  - Covered with insulation equivalent to that of the conductors
  - Insulating device suitable for purpose



General Requirements

1926.403(h)

- Each service, feeder, and branch circuit, at its disconnecting means or over current device, shall be legibly marked to indicate its purpose.

General Requirements

1926.403(i)

- Live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by cabinets or other forms of enclosures, or by another suitable method.

Wiring Design and Protection 1926.404(b)(1)(i)

- Employer shall use either ground fault circuit interrupters, ***or***

- An assured equipment grounding conductor program to protect employees

Wiring Design and Protection

1926.404(f)(3)

- Portable generators need not be grounded if:
  - Supplies only equipment mounted on the generator and/or cord and plug equipment is plugged into receptacle mounted on the generator
  - Noncurrent-carrying metal parts of equipment and grounding conductor terminals of the receptacle are bonded to generator frame

Wiring Design and Protection

1926.404(f)(3)

- Vehicle-mounted generators
  - The frame of the generator is bonded to the vehicle frame, ***and***
  - Generator supplies only equipment located on the vehicle and/or equipment plugged into the generator, ***and…***

(cont…)

Photo courtesy of FEMA.
This picture shows actual disaster site work conditions and may not illustrate proper safety and health procedures.

Wiring Design and Protection

1926.404(f)(3)

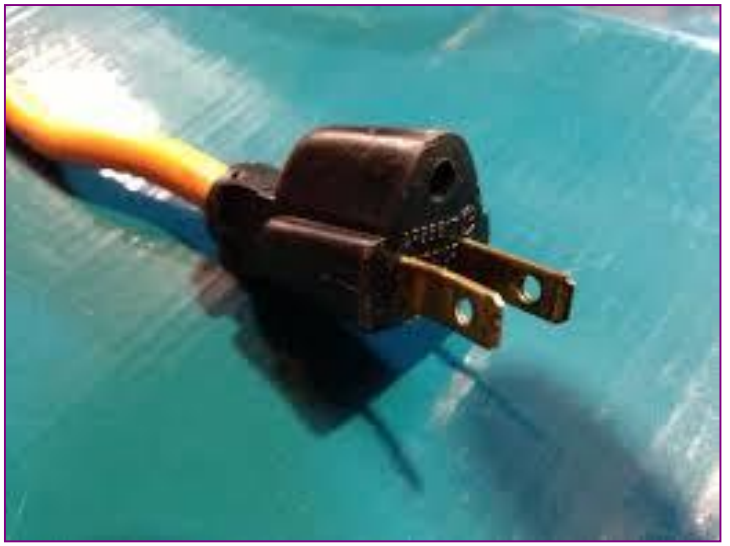
- The noncurrent-carrying metal parts of equipment and grounding conductor terminals of the receptacles are bonded to the generator frame, ***and***

- The system complies with all other provisions of this section.

Wiring Design and Protection

1926.404(f)(6)

- The path to ground from circuits, equipment, enclosures must be permanent and continuous.



Wiring Design and Protection 1926.404(f)(7)(iv)

- Equipment connected by cord and plug must be grounded, if:
  - In a hazardous location
  - Operated at over 150 V to ground
    - Except guarded motors and appliances permanently insulated from ground
  - Hand held motor-operated tools
  - Equipment used in wet and/or conductive locations
  - Portable hand lamps

Wiring Design and Protection 1926.405(a)(2)(ii)[I]

- Flexible cords and cables must be protected from damage.

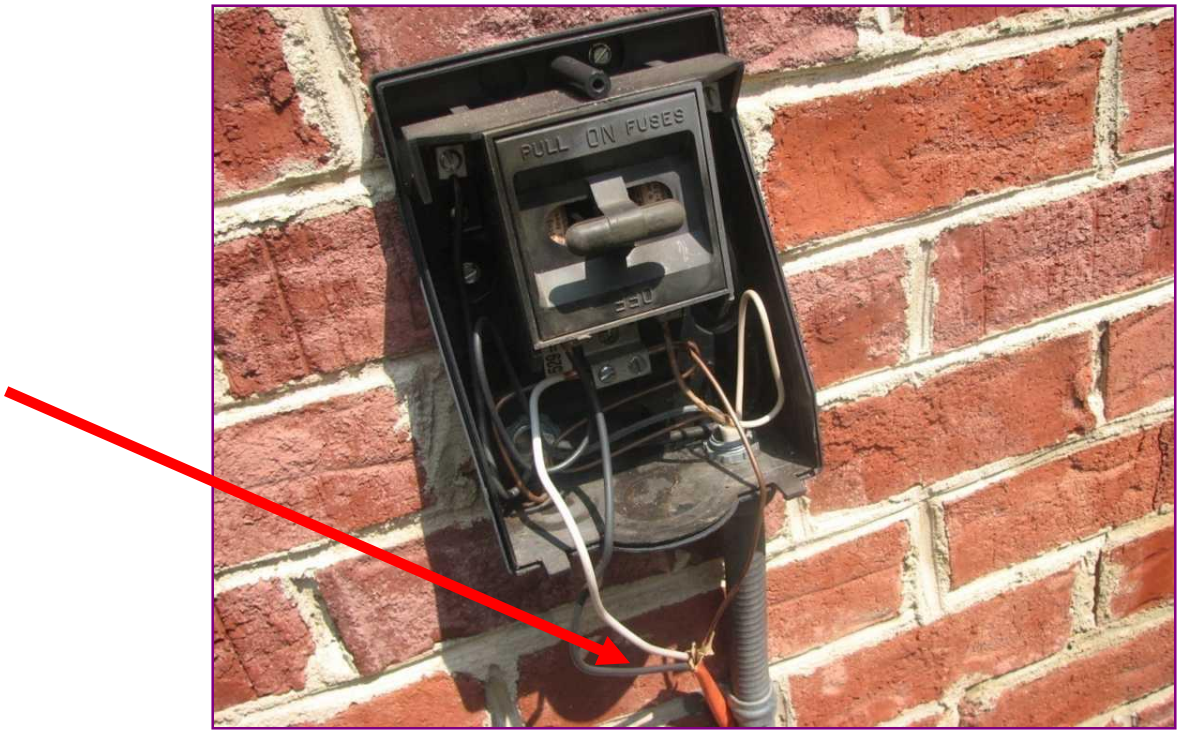
Wiring Design and Protection 1926.405(a)(2)(ii)(J)

- Extension cord sets used with portable electric tools and appliances must be of three-wire type and must be designed for hard or extra-hard usage.

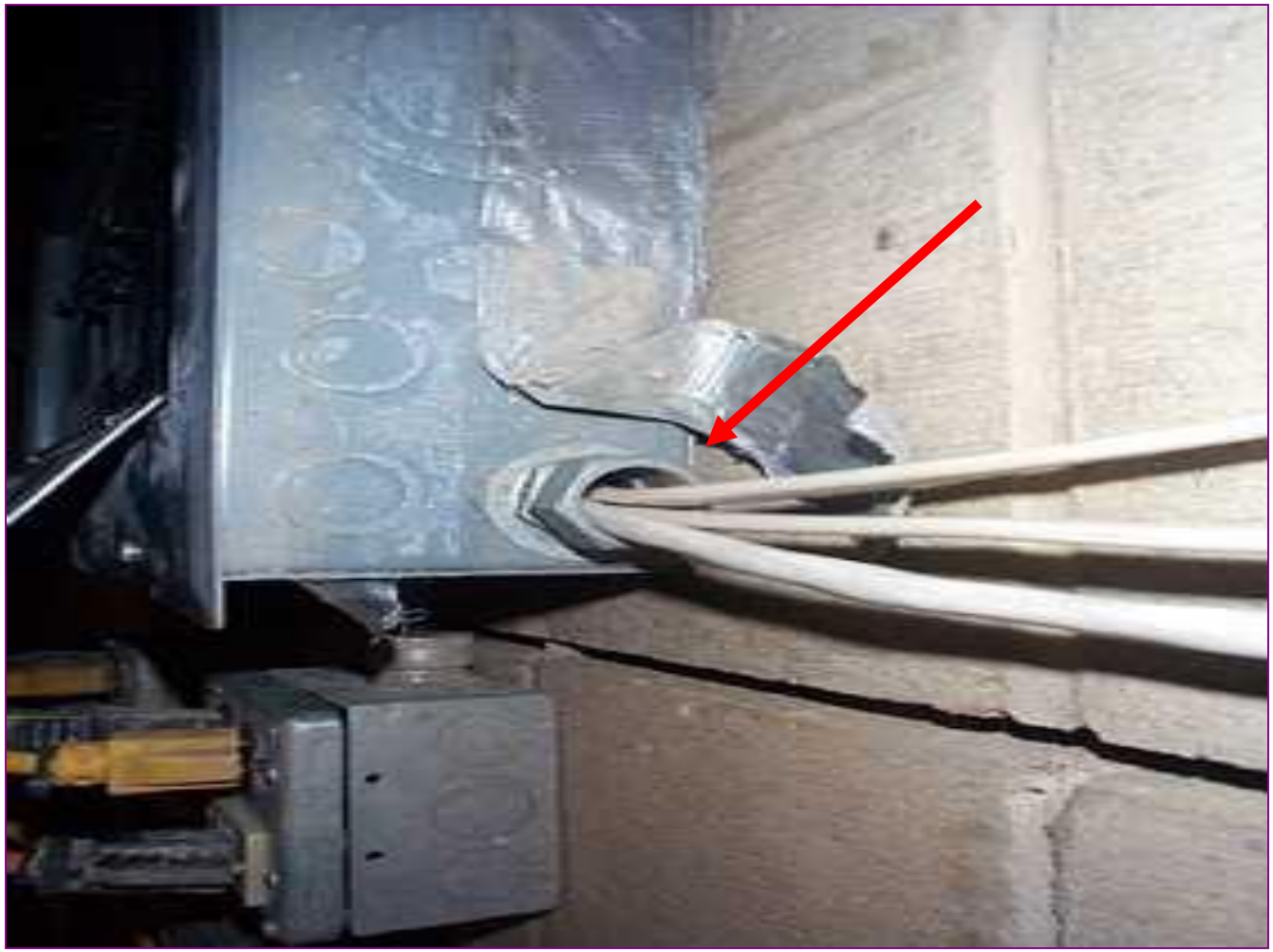
Wiring Design and Protection

1926.405(b)(1)

- Conductors entering boxes, cabinets, or fittings must be protected from abrasion.

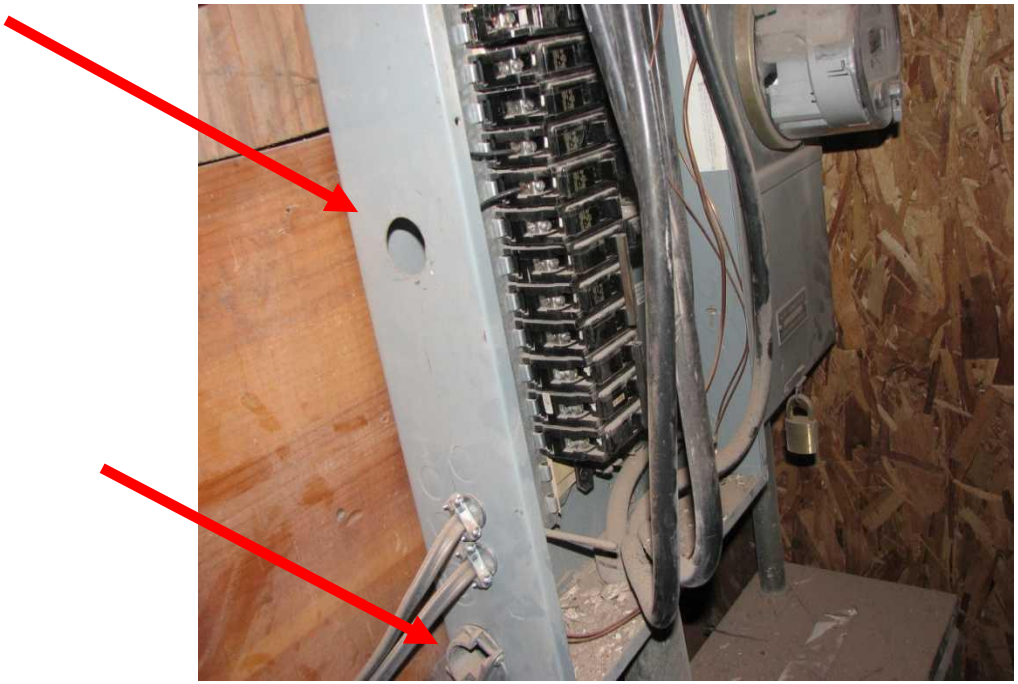


Wiring Design and Protection 1926.405(b)(1)



Wiring Design and Protection 1926.405(b)(1)

- Unused openings in cabinets, boxes and fittings must be effectively closed.



Wiring Design and Protection

1926.405(b)(2)

- All pull boxes, junction boxes, and fittings must be provided with a cover.

- If metal covers are used, they must be grounded.

Wiring Design and Protection

1926.405(g)(1)

- Flexible cords and cables must be suitable for conditions of use and location.
- SJ– Standard 300 VAC
- T – Thermoplastic
- W – Outdoor use

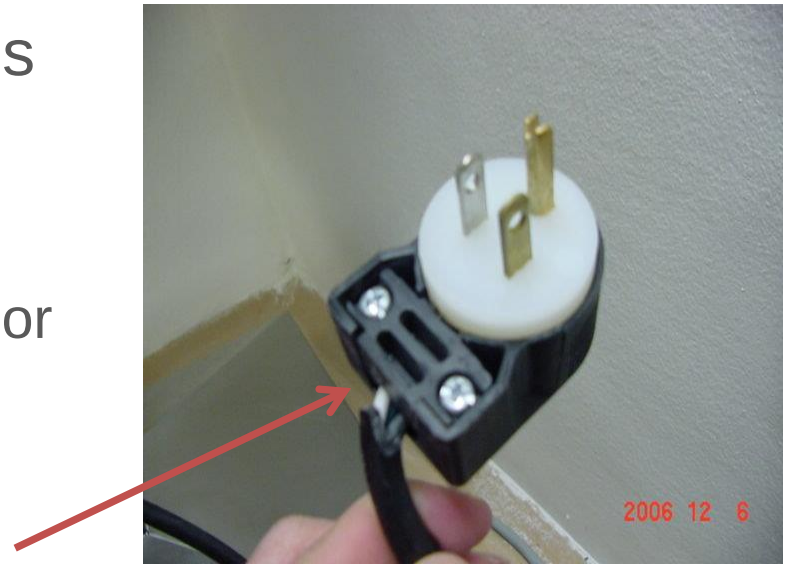
Wiring Design and Protection 1926.405(g)(1)(iii)

- **Prohibited** uses of flexible cords and cables
  - As substitute for fixed wiring of structure
  - Run through holes in walls, ceilings or floors
  - Run through doors, windows or similar openings
  - Attached to building surfaces
  - Concealed behind building walls, ceilings, or floors

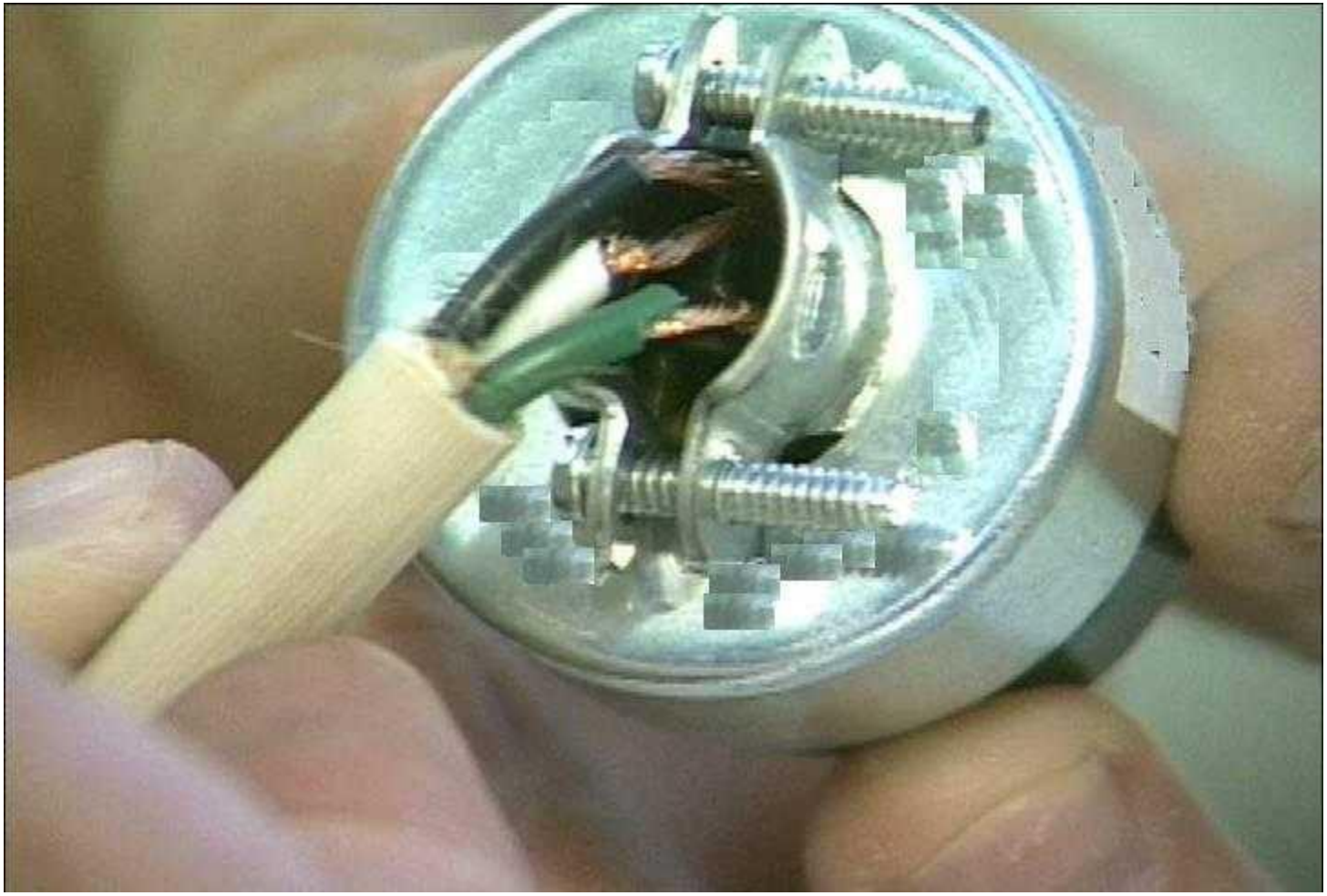
Flexible Cord Run Above Ceiling

Wiring Design and Protection 1926.405(g)(2)(iv)

- Flexible cords shall be connected to devices and fittings so that strain relief is provided.
  - Will prevent pull from being directly transmitted to joints or terminal screws



Wiring Design and Protection



Safety-Related Work Practices 1926.416(a)(1)

- Employer must not permit an employee to work in such proximity to any part of an electric power circuit.
  - If employee could contact the power circuit, it must be de-energized or guarded.

Safety-Related Work Practices 1926.416(b)(2)

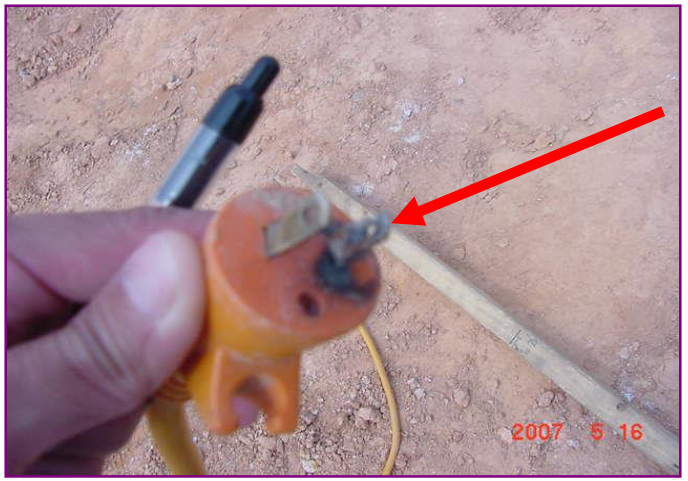
- Working spaces, walkways, and similar locations shall be kept clear of cords so as not to create a hazard to employees.

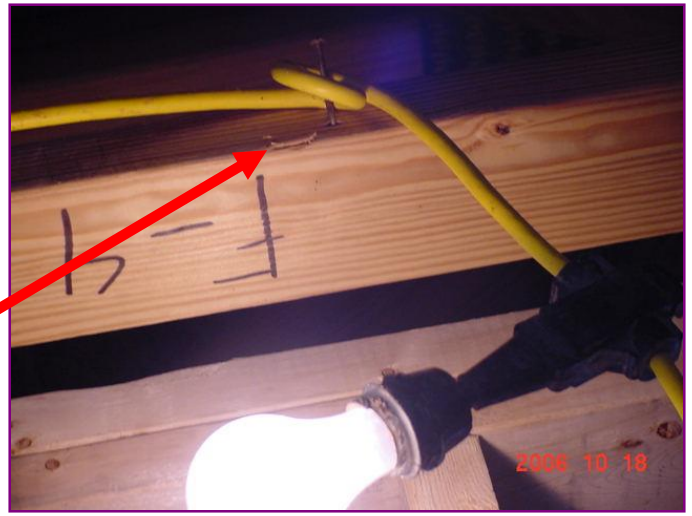
Safety-Related Work Practices

1926.416(e)

- Worn or frayed electric cords must not be used.

- Extension cords shall not be stapled, hung from nails or suspended by wire.





Common Electrical Hazards

- Explosions can be caused when electricity provides a source of ignition for an explosive mixture in the atmosphere.

- Fires are caused by overloading a circuit or appliance or by current flowing through high resistance due to faulty wiring, setting fire to insulation and surrounding materials.

Ground-Fault Circuit Interrupter

- This device protects you from dangerous shock
- If a ground fault is detected, the GFCI can shut off electricity flow in as little as 1/40 of a second, protecting you from a dangerous shock

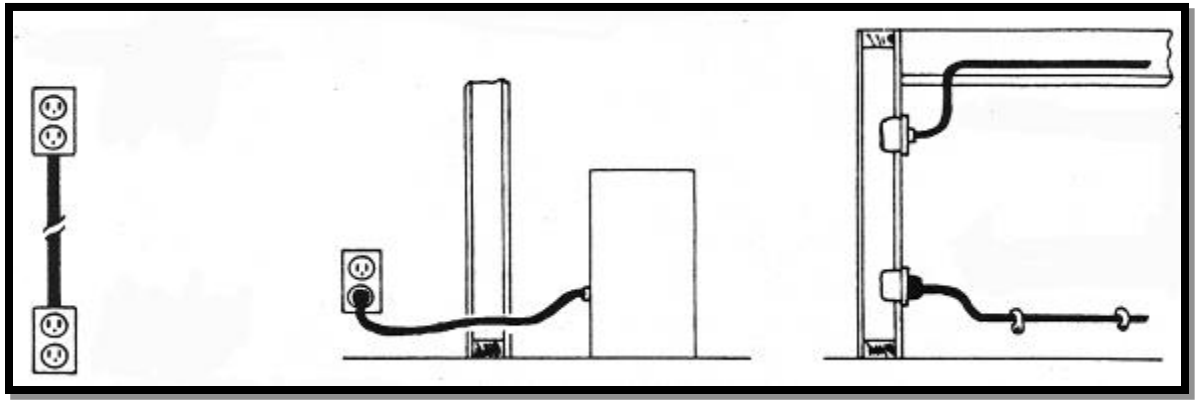
Ground Fault Receptacles

GFCI are required:

- For extension cords used for construction
- on rooftops
- temp wiring for maintenance, remodeling or repair
- receptacles used for equipment in damp or wet locations

Prohibited Uses of Flexible Cords

- As a substitute for the fixed wiring of a structure;
- Where run through holes in walls, ceilings, or floors;
- Where run through doorways, windows, or similar openings;
- Where attached to building surfaces;
- Where concealed behind building walls, ceilings, or floors; or
- Where installed in raceways, except as otherwise permitted in this subpart.



Substitute for fixed wiring

Run through walls, ceilings, floors, doors, or windows

Concealed behind or attached to building surfaces

Flexible Cords

Extension cords must be visually inspected before each use on any shift. Examine the cord for

- Missing grounding pin
- Damaged other jacket (tear in insulation)
- Possible internal damage (pinched cord)

Extension Cords

Flexible cords may be used only in continuous lengths without splice or tap.

Note: Black electrical tape does not provide suitable insulation and is not acceptable

Extension Cords

- Durably marked as to type, side, and number of conductors
- Strain relief must be provided

Cabinets, Boxes and Fittings

- Conductors entering shall be protected
- Openings shall be effectively closed
- Cable is fastened within 12” from box or raceway

Cabinets, Boxes and Fittings

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- Openings shall be effectively closed
- Cable is fastened within 12” from box or raceway

In completed installations, each outlet box shall have a cover, faceplate, or fixture canopy.

Arc Flash Event

A dangerous release of energy created by an electrical fault

- Release will contain:
  - Thermal energy
  - Acoustical energy
  - Pressure wave
  - Debris


555E

Arc Flash Intensity

Variables that effect the size and energy of an electric arc flash:

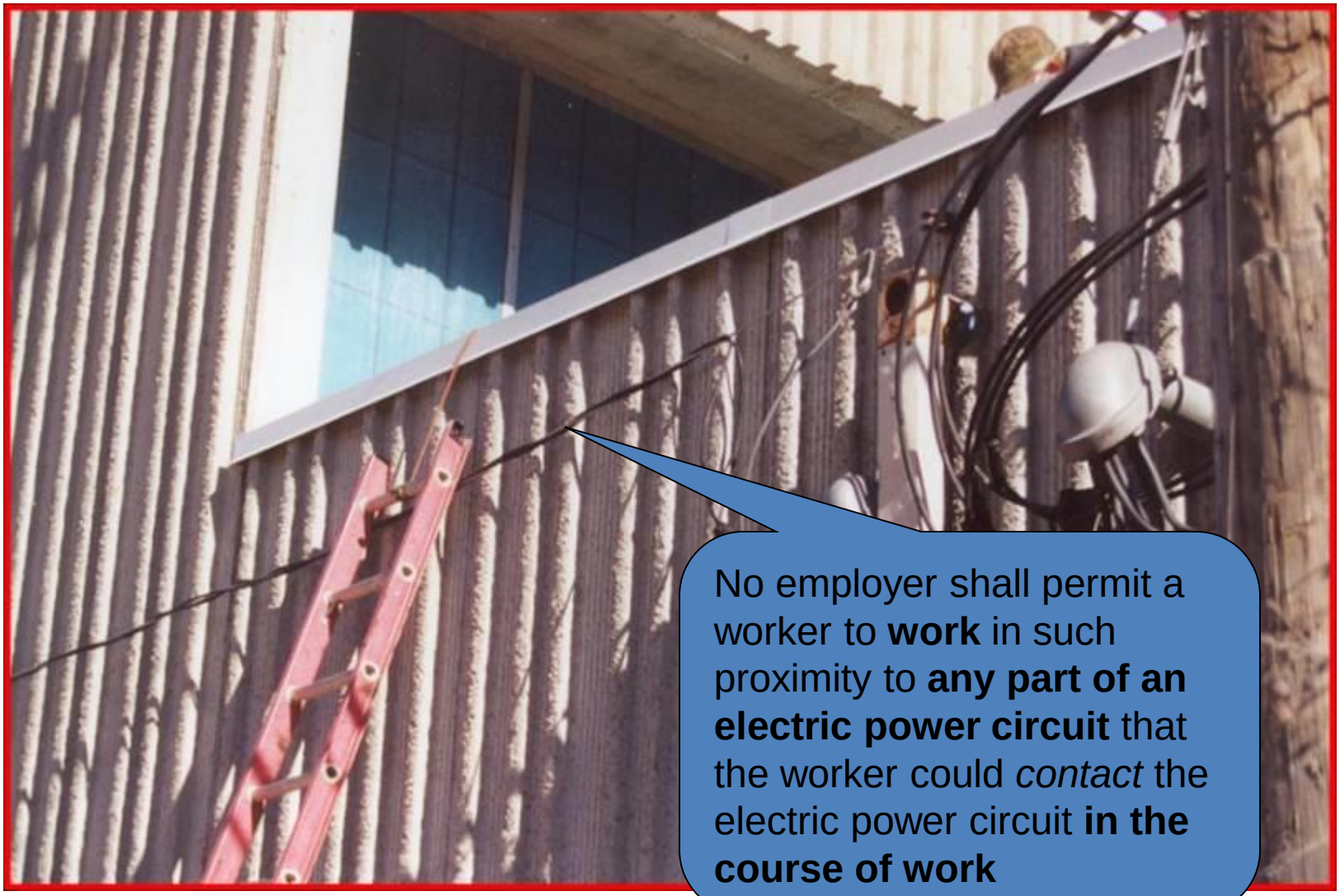
- Amperage
- Voltage
- Arc Gap
- Closure time
- Distance away from arc
- 3 phase v single phase
- Confined space

Arc Flash Events

- Can reach 35,000 F
- Fatal burns >10 feet
- Majority of hospital admissions are arc flash burns, not shock
- **30,000** arcs and **7000** burn injuries per year
- Over **2000** people admitted to burn centers yearly with severe arc flash burns

Recognize Any Hazard(s)?

Yes


No employer shall permit a worker to **work** in such proximity to **any part of an electric power circuit** that the worker could *contact* the electric power circuit **in the course of work**

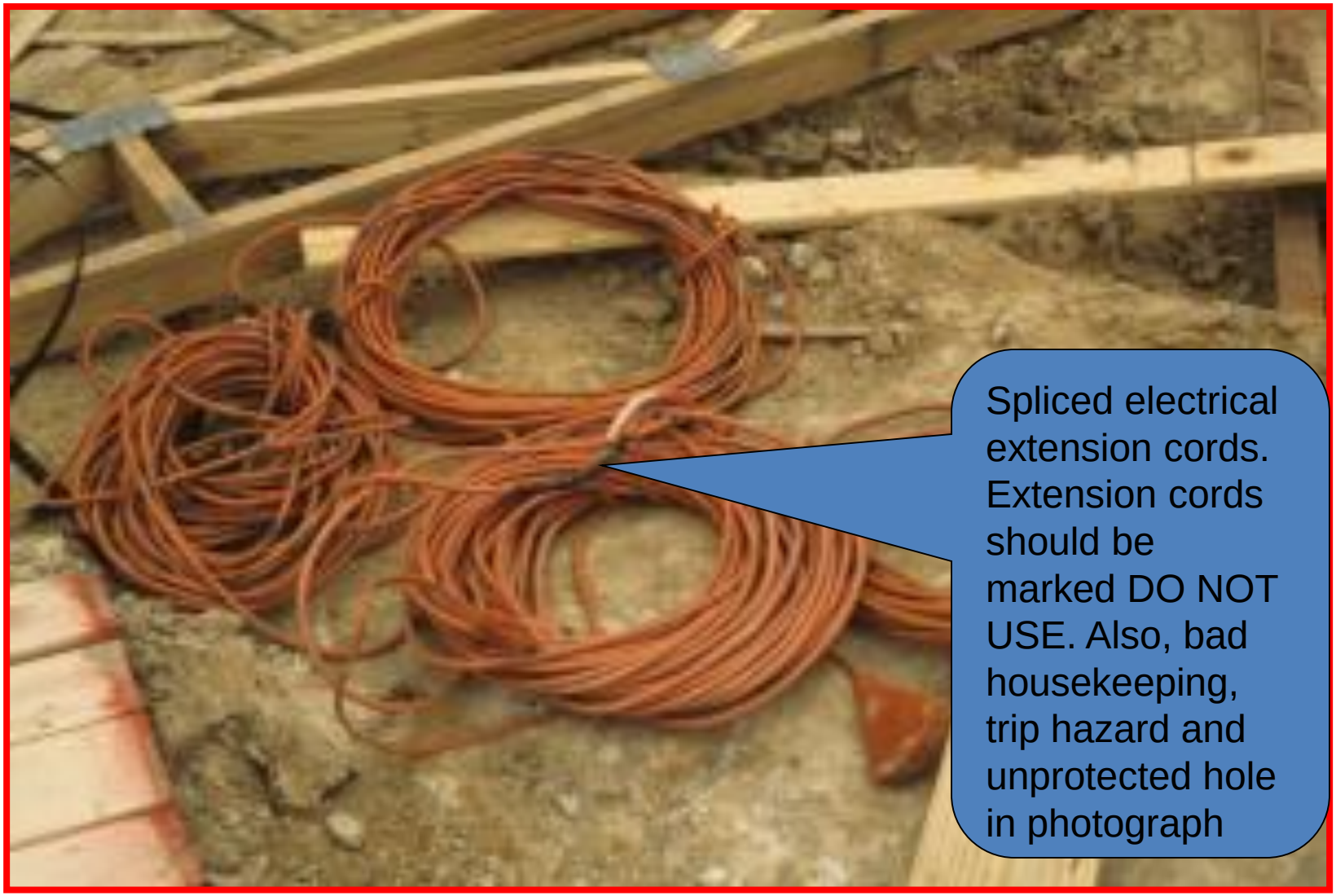
Recognize Any Hazard(s)?

Yes


SPAHN & ROSE LUMBER CO.
Crossing electrical line must be supported, protected or removed to safeguard workers

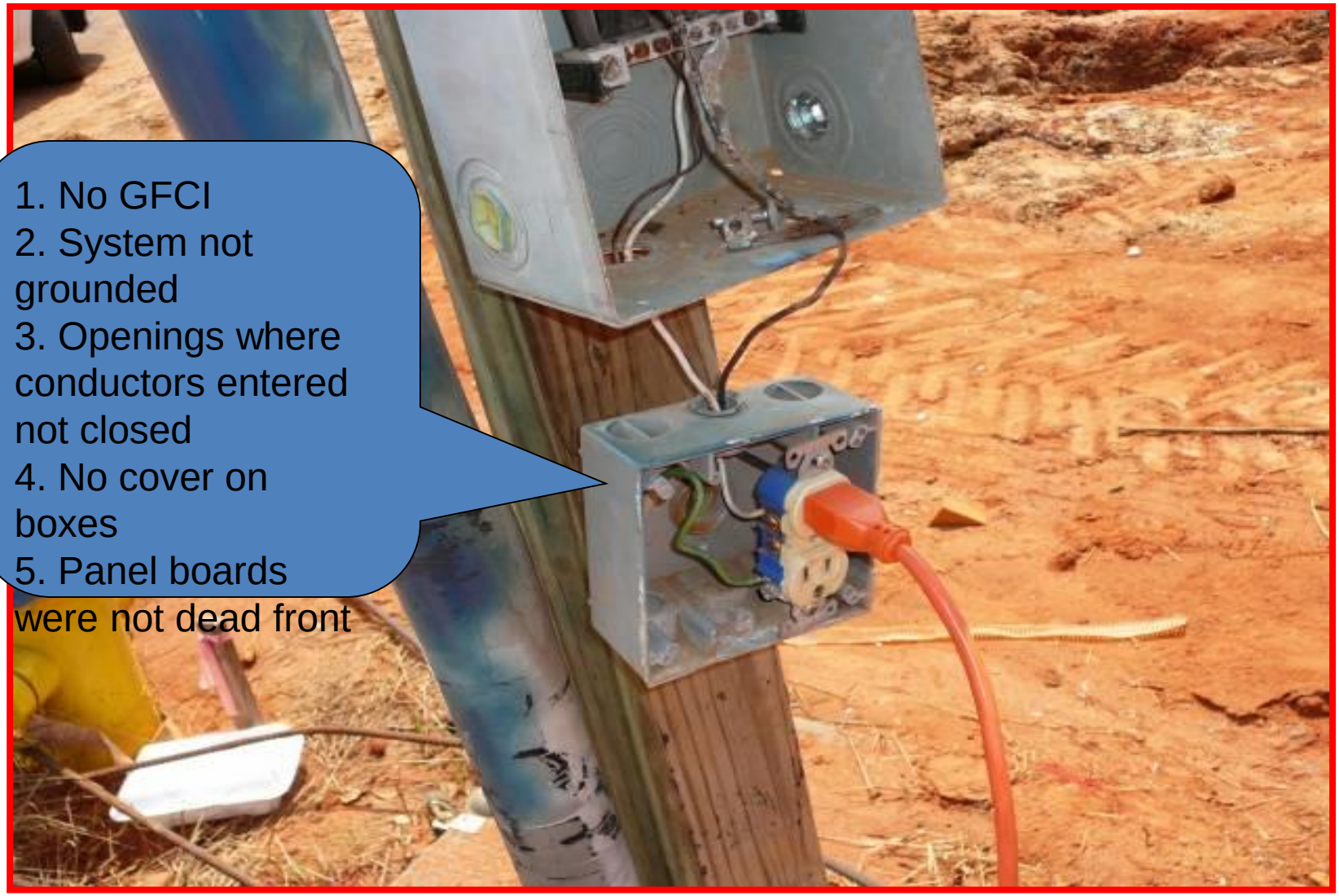
Recognize Any Hazard(s)?

Yes


Spliced electrical extension cords. Extension cords should be marked DO NOT USE. Also, bad housekeeping, trip hazard and unprotected hole in photograph

Recognize Any Hazard(s)?

YES


1. No GFCI
2. System not grounded
3. Openings where conductors entered not closed
4. No cover on boxes
5. Panel boards were not dead front

Recognize Any Hazard(s)?

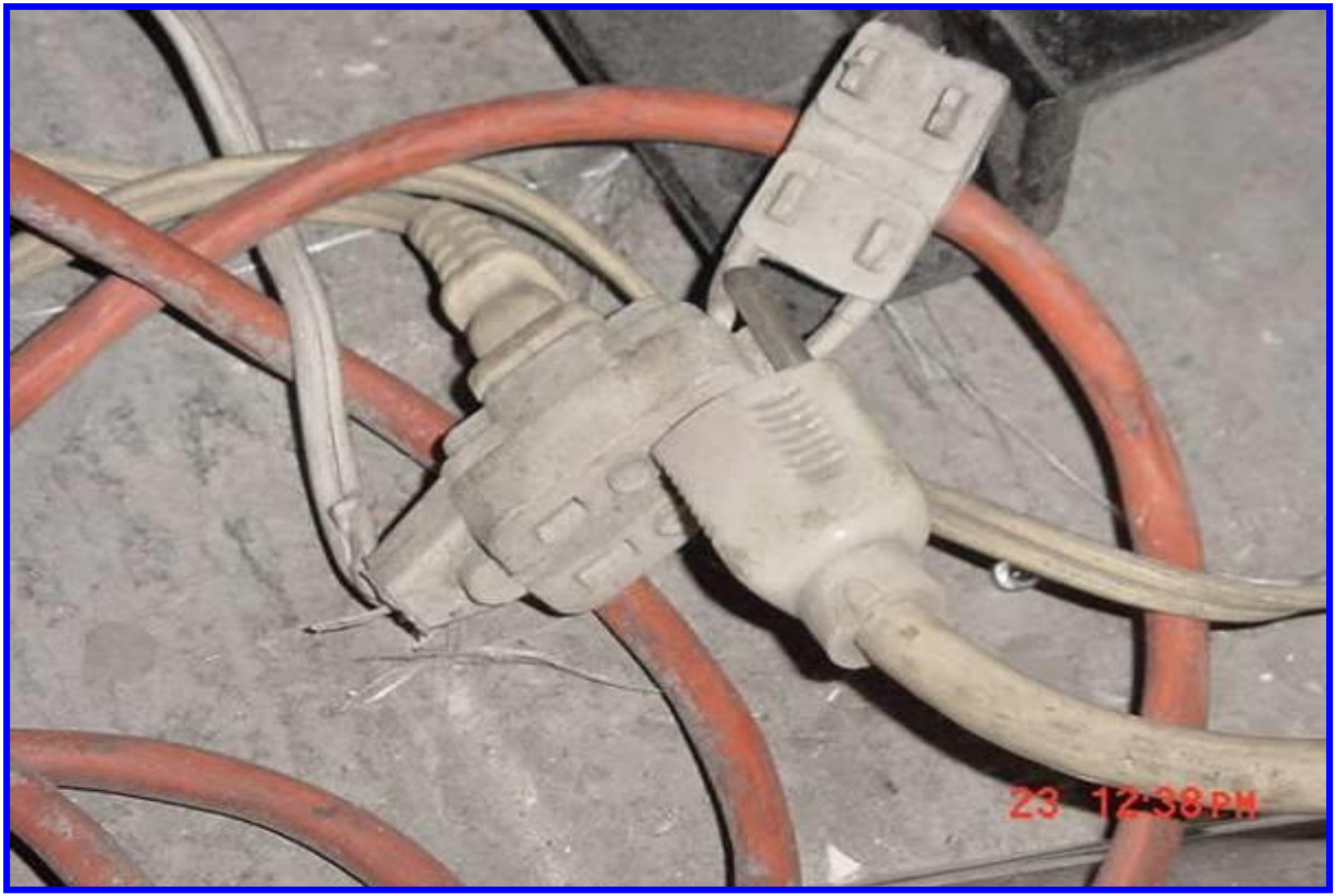
YES


DW257
Electric drill flexible cord was spliced to a non-flexible conductor with damaged insulation

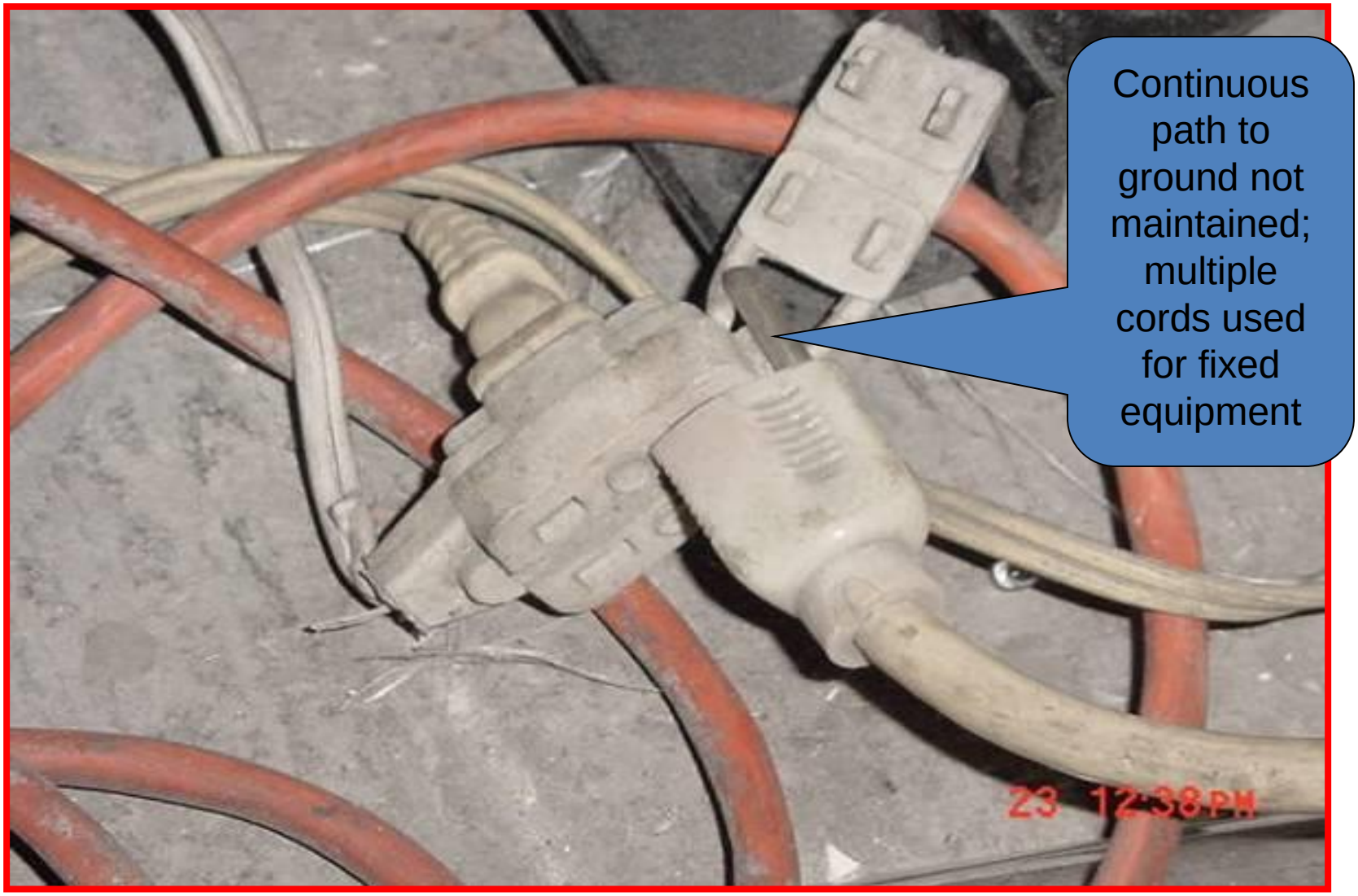
Recognize Any Hazard(s)?

Yes

Recognize Any Hazard(s)?

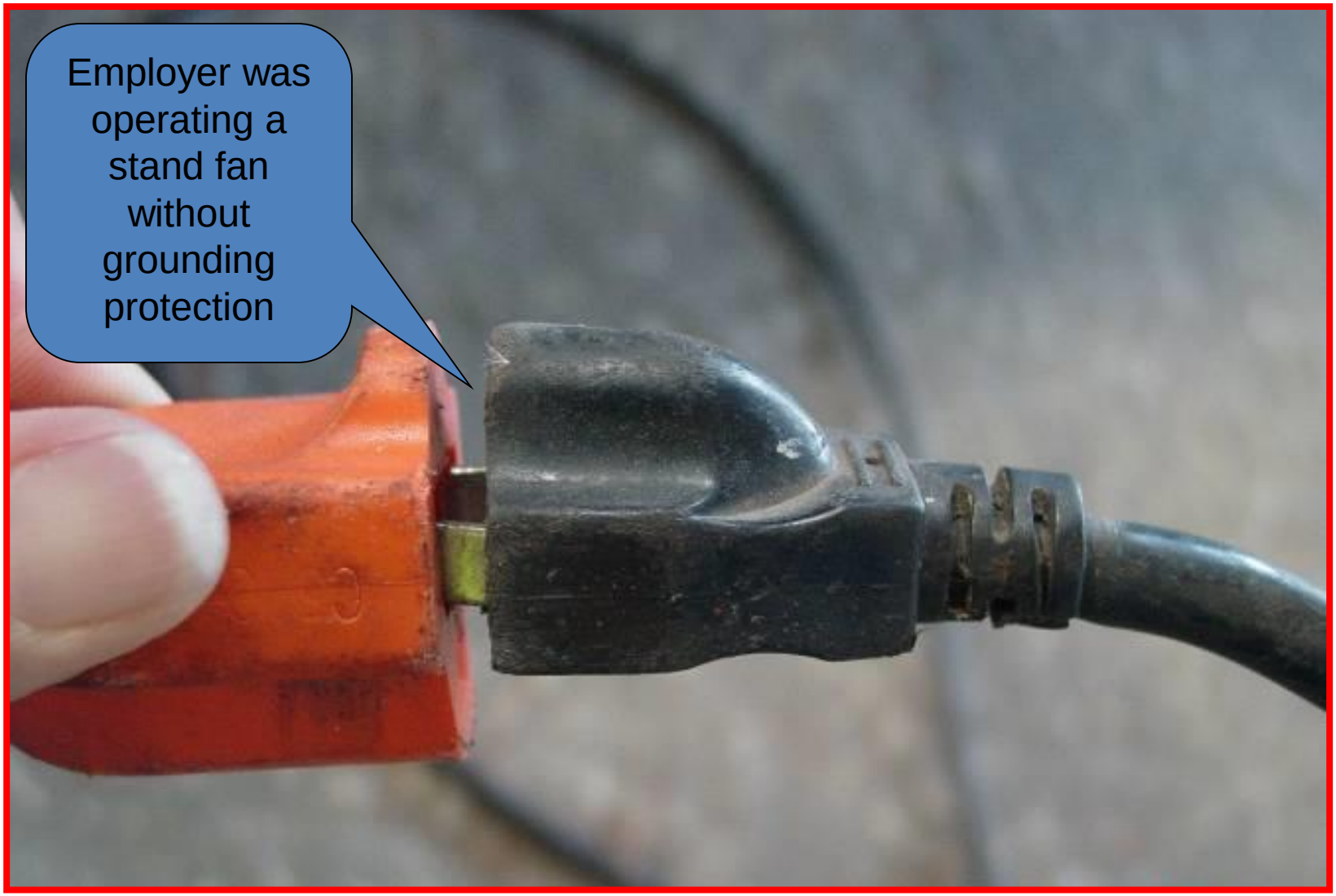


YES


Continuous path to ground not maintained; multiple cords used for fixed equipment

Recognize Any Hazard(s)?

YES


Employer was operating a stand fan without grounding protection

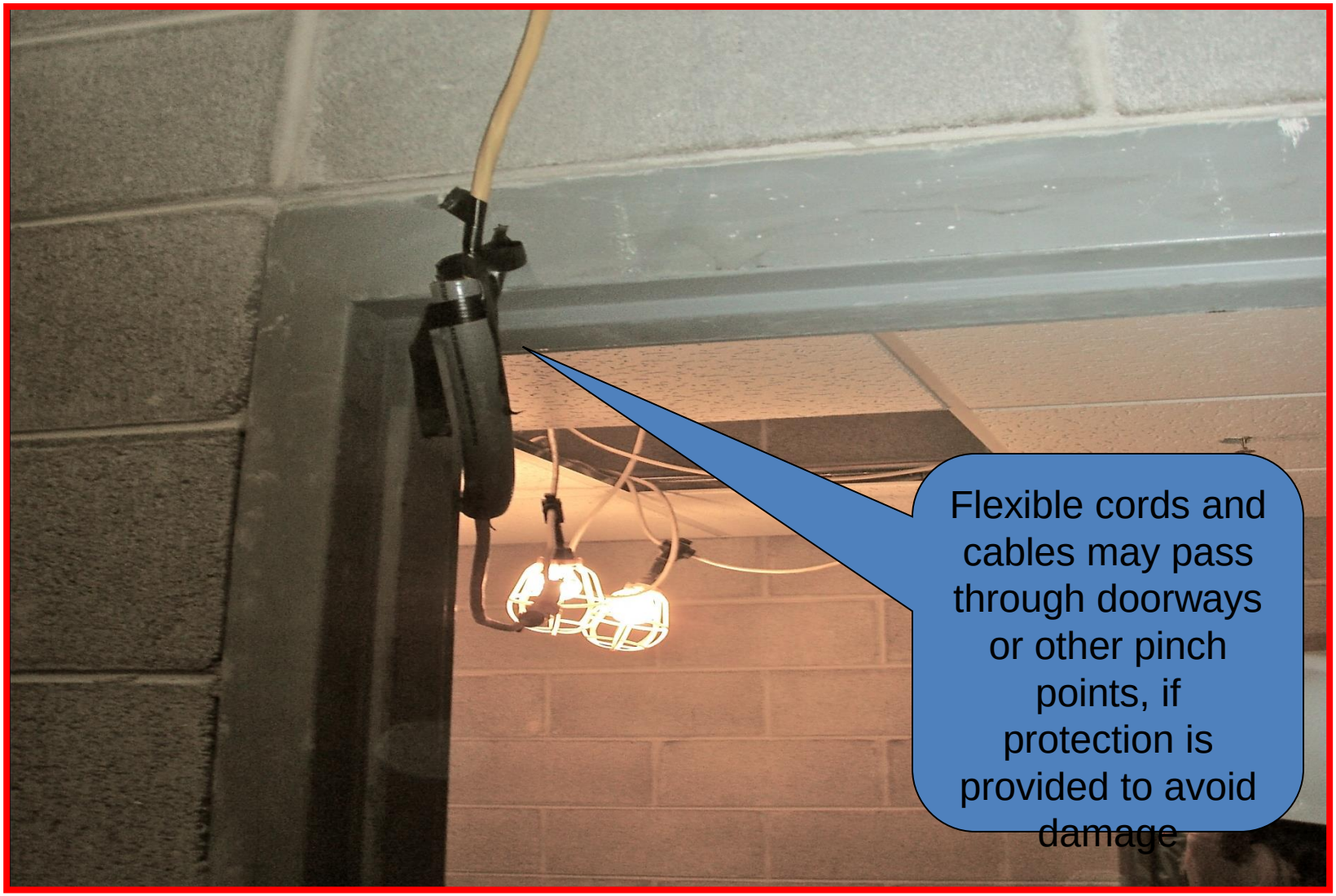
Recognize Any Hazard(s)?

Yes


Conductors entering boxes, cabinets, or fittings shall be protected from abrasion. Openings through which conductors enter shall be effectively closed

Recognize Any Hazard(s)?

Yes


Flexible cords and cables may pass through doorways or other pinch points, if protection is provided to avoid damage

Questions?